

Formula Sheet for the Classes C & D Exams Revised 05/02

F095

$$\text{Pumping rate, gpm} = \frac{0.785 \times (\text{diameter, ft})^2 \times (\text{drop, in}) \times (7.48 \text{ gal/cf})}{(\text{Time, min}) \times (12 \text{ in/ft})}$$

F096

$$\text{Volume of working solution, ml} = \frac{(\text{Beaker volume, ml}) \times (\text{dosage, mg/L})}{(\text{Stock solution conc, \%}) \times 10,000}$$

F097

$$\text{Chemical feed rate, gph} = \frac{(\text{Flow, MGD}) \times (\text{dosage, mg/L}) \times 100}{(\text{Solution strength, \%}) \times (24 \text{ hr/day})}$$

F098

$$\text{Surface loading rate, gpd/sf} = \frac{\text{Flow rate, MGD} \times 1,000,000 \text{ gal/MG}}{(\text{Diameter, ft})^2 \times (0.785)}$$

F099

$$\text{Polymer dosage, mg/L} = \frac{(\text{Polymer pumping rate, gpm}) \times (\text{polymer conc. lbs/gal}) \times 1,000,000}{\text{Sludge flow rate, gpm} \times 8.34 \text{ lbs/gal}}$$

F100

$$\text{Retention \%} = \frac{(\text{Retentate conc, mg/L}) - (\text{permeate conc, mg/L}) \times 100\%}{(\text{Retentate conc, mg/L})}$$

F101

$$\text{Average transmembrane pressure, psi} = \frac{(\text{Inlet pressure, psi} + \text{outlet pressure, psi}) - \text{permeate pressure, psi}}{2}$$

F102

$$\text{Trickling filter organic loading, lbs/day/1000 cf} = \frac{(\text{BOD conc, mg/L}) \times (\text{flow rate, MGD}) \times (8.34) \times (1000)}{(0.785) \times (\text{diameter, ft})^2 \times (\text{filter depth, ft})}$$

F103

$$\text{RAS, MGD} = \frac{(\text{Settled volume, ml/L}) \times (\text{influent flow rate, MGD})}{(1000 \text{ ml/L}) - (\text{settled volume, ml/L})}$$

F104

$$\text{RAS, MGD} = \frac{(\text{Inflow rate, MGD}) \times (\text{MLSS, mg/L})}{[1,000,000 / (\text{SVI, ml/gram})] - (\text{MLSS, mg/L})}$$

F105

$$\text{Sludge age, days} = \frac{(\text{Tank volume, MG}) \times (\text{MLSS, mg/L})}{(\text{Inflow rate, MGD}) \times (\text{primary effluent SS, mg/L})}$$

F106

$$\begin{aligned} \text{F/M, lb COD/day per lb MLVSS} = \\ \frac{(\text{Flow, MGD}) \times (\text{COD, mg/L}) \times (8.34 \text{ lbs/gal})}{(\text{Solids under aeration, lbs}) \times (\text{volatile fraction})} \end{aligned}$$

F107

$$\begin{aligned} \text{Waste rate of sludge, lbs/day} = \\ [(\text{SS in aeration tank, lbs}) / (\text{MCRT, days})] - [(\text{inflow, MGD} \times \text{effluent SS, mg/L}) \times 8.34 \text{ lbs/gal}] \end{aligned}$$

F108

$$\begin{aligned} \text{Phosphorus to be added, lbs/day} = \\ \text{BOD lbs/day} \times \text{P/BOD (desired ratio)} - \text{P in wastewater, lbs} \end{aligned}$$

F109

$$\begin{aligned} \text{Volatile acid alkalinity, mg/L} = \\ (\text{Titrant to pH 7.0, ml} - \text{titrant to pH 4.0, ml}) \times (2500 / 50) \end{aligned}$$

F110

$$\begin{aligned} \text{Desired COD loading, lbs/day} = \\ (\text{COD loading rate, lbs COD / lbs VS}) \times \text{VS, lbs} \end{aligned}$$

F111

$$\begin{aligned} \text{Sludge produced, lbs/day} = \\ \text{Flow, MGD} \times (\text{influent BOD, mg/L} - \text{effluent BOD, mg/L}) \times 8.34 \times \text{yield factor} \end{aligned}$$

F112

$$\begin{aligned} \text{Thickened sludge volume, gal/day} = \\ \frac{\text{Sludge, lbs/day}}{8.34 \text{ lbs/gal}} \times \frac{100\%}{\text{Sludge solids conc\%}} \end{aligned}$$

F113

$$\begin{aligned} \text{Sludge/volume ratio, days} = \\ \frac{\text{Surface area, sf} \times \text{sludge blanket level, ft} \times 7.48 \text{ gal/cu ft}}{\text{Sludge pumping rate, gal/day}} \end{aligned}$$

F114

$$\begin{aligned} \text{Solids loading, lbs/hr/sf} = \\ \frac{\text{Flow, gpm} \times 60 \times 8.34 \text{ lbs/gal} \times \text{SS \%}}{\text{Liquid surface area, sf} \times 100} \end{aligned}$$

F115

Air to solids ratio =

$$\frac{(\text{Air supply rate, cfm}) \times 0.075 \text{ lb/cf} \times 100\%}{(\text{Solids feed rate, gpm}) \times \text{sludge conc \%} \times 8.34 \text{ lbs/gal}}$$

F116

Feed time to a centrifuge, min =

$$\frac{\text{Storage volume, cf} \times \text{basket sludge conc \%} \times 62.4 \text{ lbs/cu ft}}{\text{Flow, gpm} \times \text{influent solids, \%} \times 8.34 \text{ lbs/gal}}$$

F117

Increase of aerobic digestion time, days =

$$\frac{\text{Aerobic digester vol, gal} \times \text{increase in sludge conc, \%}}{\text{Initial sludge flow, gal} \times \text{initial sludge conc, \%}}$$

F118

Air feed rate, cfm =

$$(\text{Air rate required, cfm/cf}) \times (\text{volume of digester, cf})$$

F119

Oxygen uptake rate, mg/L/hr =

$$\frac{[(\text{D.O. \#1, mg/L}) - (\text{D.O. \#2, mg/L})] \times (60 \text{ min/hr})}{(\text{Time \#2, min} - \text{time \#1, min})}$$

F120

NaOH needed, lbs =

$$\frac{(\text{NaOH to a jar, mg/L}) \times (\text{digester volume, gal}) \times (3.78 \text{ L/gal})}{(454 \text{ gram/lb}) \times (1000 \text{ mg/gram})}$$

F121

Polymer dosage for sludge, lbs/ton =

$$\frac{(\text{Polymer solution, \%}) \times (\text{polymer added, ml}) \times 2}{\text{Sludge volume, L} \times \text{sludge conc, \%}}$$

F122

Polymer dosage, lbs/ton =

$$\frac{\text{Polymer solution conc, \%} \times \text{polymer added, gpm} \times 2,000 \text{ lbs/ton}}{\text{Sludge conc, \%} \times \text{sludge flow rate, gpm}}$$

F123

Vacuum filter yield, lbs/hr/sq ft =

$$\frac{\text{Sludge loading, lbs/day} \times \text{recovery, \%} / 100\%}{\text{Duration of filter operation, hr/day} \times \text{filter area, sf}}$$

F124

Required filter run time, hr/day =

$$\frac{\text{Sludge solids loading, lbs/day} \times \text{solids recovery, \%}}{\text{Filter yield, lbs/hr/sf} \times \text{filter area, sf} \times 100\%}$$